MAGNETIC PROPERTIES OF DIABASE SAMPLES SHOCKED EXPERIMENTALLY IN THE 4.5 TO 35 GPa RANGE; L.J. Pesonen[1], A. Deutsch[2], U. Hornemann[3] and F. Langenhorst[4]. [1]Geological Survey of Finland, P.0. Box 96, FIN-02151 Espoo, Finland (e-mail <lauri.pesonen@gsf.fi>); [2]Institut f. Planetologie, Univ. Münster, D-48149 Münster, Germany (e-mail <deutsca@uni-muenster.de>); [3]Ernst-Mach-Institut, Hauptstr. 18, D-79576 Weil a. Rhein, Germany, [4]Museum f. Naturkunde, Humboldt-Univ. Berlin, D-10115 Berlin, Germany (e-mail <falko=langenhorst@rz.hu-berlin.de>).

Summary. We report preliminary results of experimentally shocked disks of the 1040 Ma Laanila diabase. These are with increasing shock pressure (i) increase of the high-temperature susceptibility, (ii) increase in the NRM intensity, and (iii) increase of both the coercive force, and the coercivity remanence.

Introduction. Shock-induced changes in magnetic properties of rocks play an important role in modeling the magnetic anomalies of impact structures [1, 2]. In order to better understand effects of shock on the magnetic properties of rocks, research has been performed at nuclear test sites and with various laboratory shock devices [*e.g.*, 3-6]. In a pilot study, we have carried out shock recovery experiments at 4.5, 15, 25, and 35 GPa using a conventional high-explosive set-up (composition B or TNT) with an ARMCO steel sample container, surrounded by a momentum trap of the identical material [7, 8]. Since the samples were shocked inside the highly magnetic steel container, the prevailing magnetic field was roughly five times higher than the ambient field. After the shock, the containers cooled down slowly to ambient temperatures. The estimated post-shock temperatures of the samples range from ambient temperature (4.5 GPa) up to about 1400 K (35 GPa).

For the experiments, 1 mm thick, surface-polished disks with ∅ of 10 mm were cut out of the Laanila diabase dike. Samples of this diabase, located in northeastern Finland, were selected for the experiments since it has been extensively studied by petrophysical and palaeomagnetic methods [9].

Results: Susceptibility. Low temperature susceptibility curves do not show any marked change by shock. The high-temperature susceptibility curves show an increase in their irreversibility with shock intensity. Nearly pure magnetite (Tc ≈ 560°C) is the main carrier of the magnetization [8]. Also, it appears that shock is enhancing the magnetite Hopkinson peak in the susceptibility vs. temperature curves of this diabase. The bulk susceptibility decreases with increasing shock thus confirming previous observations on the effect of shock on susceptibility [*e.g.*, 3, 6].

NRM: A remarkable feature in the NRM data is a five-fold increase in the NRM intensity as a function of increasing shock. Part of this effect is due to difficulties with the sample holder, described above. Since the direction of the measured NRM is along the direction of the shock and along the maximum field inside the container, but nearly perpendicular to the pre-existing NRM direction, the samples have acquired a new and strong, presumably shock remanent magnetization (SRM). It is possible that the post-shock temperatures are augmenting the growth of the new SRM [6, 10, 11]. The directional data support this since the most highly shocked samples (25, and 35 GPa) reveal only one component (shock), whereas, the weakly shocked samples show evidences of two components: a new (probably shock related) and another one (probably the pre-shocked NRM). The normalized a.f. curves of the NRM's show the hardening effect of shock on NRM: the median destructive field (MDF) increases with increasing shock (Fig.1a). Similar trends have been reported earlier for experimentally shocked rocks, and for impactites from various impact craters [*e.g.*, 4, 5, 6, 10, 11].

Hysteresis properties: Figure 1b shows an example of the shock-induced changes in magnetic hysteresis properties of the samples. The coercive force (B_c) systematically increases with increasing shock. Also the coercivity of remanence (B_{cr}) is increasing as a function of shock. The mechanism beyond the magnetic shock hardening is probably related to changes in the domain sizes of magnetite grains and/or to production of lattice defects in magnetite. The modal components, particularly magnetite, of the reference, and the shocked samples, are currently investigated by TEM techniques.

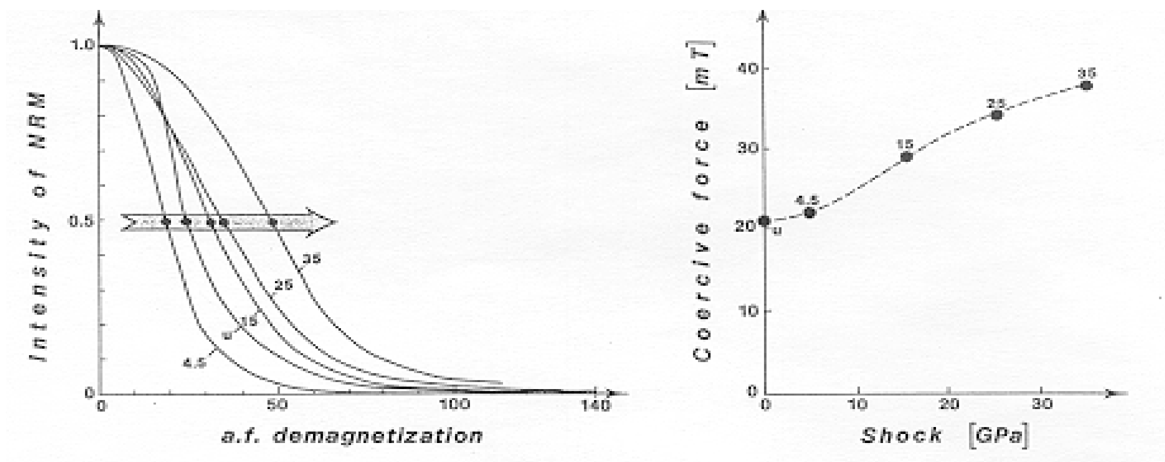

Fig.1. (a) The median destructive field of NRM and (b) the coercive force (B_c) as a function of shock.

References. [1] Pilkington, M. and Grieve, R.A.F. (1992) *Rev. Geophys., 309,* 161-181; [2] Plado, J. et al. (1*996) Meteoritics & Planet. Sci., 31*, 289-298; [3] Hargraves, R. B. and Perkins, W. E. (1969) *JGR, 74*, 2576-2589; [4] Pohl, J. et al. (1975) *J. Geophys., 41,* 23-41; [5] Cisowski, S.M. et al. (1976) *Proc. Lunar Sci. Conf., 7th,* 3299-3320; [6] Cisowski, S.M. and Fuller, M. (1978) *JGR, 83, B7,* 3441-3458; [7] Müller, W. F. and Hornemann, U. (1969) *EPSL, 7*, 251-264; [8] Langenhorst, F. and Deutsch, A. (1994) *EPSL, 125*, 407-420; [9] Mertanen, S. et al (1996) *Geol. Soc. Spec. Publ., 112* (ed. Brewer, T.S.), 331-358; [10] Wasilewski, P.J. (1973) *The Moon, 6,* 264-291; [11] Cisowski, S.M. and Fuller, M. (1983) *Adv. Spa. Res., 29,* 35-39.

Acknowledgments. This work is supported by a DAAD/Finish Academy of Science grant to L.J. Pesonen and A. Deutsch.